

Prototyping Participation: Experimenting with community wireless networking technology for digital sovereignty

Hagit Keysar (Museum für Naturkunde Berlin)

Elizabeth Calderón Lüning (University of the Arts Berlin – Weizenbaum Institute)

Andreas Unteidig (University of the Arts Berlin – Weizenbaum Institute)

Introduction

This paper seeks to critically explore the potential role of critical and collaborative prototyping processes based on do-it-yourself and open-source technologies, for socially and materially experimenting with recent formulations of digital sovereignty. It offers a case-study analysis of a collaborative prototyping process, the MAZI project, which focuses on developing a do-it-yourself (DIY) Community Wireless Network (hereafter, CWN) to engage residents in critical discourse and public action around Berlin’s technologically mediated futures. Situating the MAZI project in critical perspectives on prototyping and connecting it to the overarching discussions on digital sovereignty, we want to flesh out the insights and dilemmas such collaborative processes may bring about.

Namely, we discuss three strands of tensions and conflicts that emerged within the project – the potential contradictions between experimental realms and normative expectations, collision of different epistemic systems that may exclude or alienate participants, and the question of sustainability within project-based interventions. While the transformative potentials of DIY practices and open-source technology have been widely celebrated, we wish to shed light on problems of participation in times of surging participatory and collaborative technologies and mindsets. Paying careful attention to and reflecting on conflicts, tensions, and oversight, we argue, is crucial for developing politically conscious design tools and practices, particularly for advancing community-driven futures for digital sovereignty.

The term digital sovereignty has percolated in the last decade as a prescriptive normative term to describe various forms of autonomy, self-determination, and independence in relation to digital infrastructures, technologies, and data (Couture, 2019; Pohle, 2020). When connected to the digital, “sovereignty”, the right of nation states to protect their territory through the exercise of power, can be described in three main strands. First, the traditional nation-state perspective on digital sovereignty conveys states protecting the privacy rights of its citizens

towards other states¹ (Couture, 2019; Floridi, 2020; Pohle, 2020; Thiel, 2019) or defending democratic procedures against external manipulations through disinformation campaigns (Thiel, 2019). Second strand refers to the need for recalibration of power between public and private sector. With a market that is controlled by a few private enterprises, governments are dependent on corporate tools and expertise for almost anything digital creating a de facto corporate sovereignty while severely undermining democratic decision-making processes and control over the development, deployment, and management of digital infrastructures, data, and analysis (Floridi, 2020; Pohle & Thiel, 2021 upcoming; Thiel, 2019).

The third strand of digital sovereignty breaks from the dominant role of the state by aiming for *digital self-determination and autonomy through collective control* mobilised by civil society entities and social movements (Couture, 2019).² The argument is that a sovereign people, in this new context, needs a level of technical competence and reflection that is as critical as it is prerequisite (Ritzi, 2019). Closely connected to social justice narratives, this formulation of digital sovereignty is used to assert control of technologies and digital infrastructures and focuses on the development and use of digital tools that are conceived within community ecosystems (Couture, 2019; Haché, 2014).

These formulations of digital sovereignty share a common quality: they describe the contention over the very definition of digital sovereignty and the forms of control and regulations needed for the development and management of all things digital, from data, software and services to hardware and infrastructures (Floridi, 2020). While the first three perspectives of digital sovereignty are shaped from a top-down perspective, the third strand builds on community awareness raising, participation and technology appropriation. In that regard, prototyping processes of do-it-yourself and open-source technologies, and participatory design practices can be seen as the rehearsal and formative spaces for advancing such a community-driven imagination of digital sovereignty that focuses on self-determination and autonomy.

The MAZI project, a three-year EU-funded research, aimed at creating social and material infrastructures for digital self-determination and technological inclusion. The overarching objective of the MAZI project was to develop interventionist methodologies that address increasing corporate centralization of digital infrastructures, platforms and services and

¹ see Edward Snowden revelations of systematic data collection of individuals by the National Security Agency of the United states in 2013

² It is set closer to ideas such as ‘food sovereignty’ coined by Via Campesina at the World Food Summit in 1996 (Anderson, 2018).

the uniform modes of digital interaction that emerge as a result of the steady closure of digital ecosystems. The idea of digital sovereignty within the MAZI project focused on fostering control over technologies and digital infrastructures as well as explicitly on the development and use of digital tools that are conceived within neighbourhood settings. The project aimed at practicing participatory technological development in hyper local contexts, by engaging participants in a collaborative prototyping process, and creating interdisciplinary spaces for exploring the underlying structure of technology itself and rehearsing what digital sovereignty might actually mean.

A growing body of literature in Sociology, Anthropology, Design Research and Science and Technology Studies (STS) has expanded the meanings of prototyping beyond simply an experimental process for the development and design of technological objects³ (Guggenheim 2014; Jiménez 2014; Christopher M. Kely 2010; Lezaun and Calvillo 2014; Marcus 2014; Suchman 2000). Research in these fields delves into the social and political role of prototyping, or technology-in-the-making, for developing material forms of participation and democratic practices. The political potentials of prototyping were particularly advanced since the 2000s, when the development of interactive products, in industries such as mobile devices, laptops, and interactive games, has created a need for rapid processes of interdisciplinary design and engineering, in which prototypes play a central role (Bogers and Horst 2012; Kurvinen, Koskinen, and Battarbee 2008). As Suchman et al. (2002) show, interdisciplinary reconstructions of prototypes allow to develop innovative processes that transform the focus on invention as a singular event to its reconstruction as diverse collaborations across different social environments. This shift brings forth “an interest in ongoing practices of assembly, demonstration and performance” that reconstructs human actions and reconfigures social and material relations (Suchman, Trigg, and Blomberg 2002, 163–66).

The shift of attention and practice from prototyping artifacts to prototyping processes and reconstructing social and material relations, has gained particular momentum in the past decade with the proliferation of information technologies and digital networks. In particular, open-source technologies as well as the re-emergence of do-it-yourself (DIY) and hacking practices seem to radicalize the proclaimed democratization through collaborative and generative processes of prototyping, by serving as sites of knowledge co-production and knowledge commons (Benkler 2006; C. M. Kely 2008; Powell 2012). Therefore, the experimental character of the MAZI prototype in keeping technical and design decisions open,

³ A prototype is an initial model of a product, object, or design that is still in stages of development, open for rethinking and iteration (Hackney and Manar, 2015)

fleshed out the potential role of prototyping processes for translating “big” questions on the meaning of digital sovereignty into hands-on engagement and encounter. Not knowing what the “right” solution is, and learning collaboratively how to create, practice, fail/succeed in the process has played a role as a heuristic for exploring the possibilities and barriers for developing community-driven digital sovereignty.

MAZI: Prototyping participation for Berlin’s digitally mediated futures

Information and communication technology (ICT) has become strongly commercialized and centralized by a few quasi-monopolized technology corporations (Antoniadis, 2014; Floridi, 2020; Pohle, 2020; Pohle & Thiel, 2021 upcoming). While individuals and collectives are clearly benefitting from the expansion of globalized ICT, they are most often demoted to consumers void of political agency. The power of corporate technologies lies not only in controlling the back-end design of data infrastructures, but rather in the highly specialized capacities to aggregate massive amounts of data and analyze them to produce new kinds of knowledge (Antoniadis, 2014; Boyd & Crawford, 2012; Mayer-Schönberger & Cukier, 2013).

Building towards an understanding of digital sovereignty as self-determination and autonomy through collective control, there is a need for awareness and understanding of the current digital condition to be able to (re-)appropriate technologies, data, and content (Couture 2019). For empowered participation that enables people to shape their own (digital) environments, robust skills need to be developed (Zamenopoulos, et.al, 2018). In addition, concrete and viable alternatives technological solutions need to be developed for a different distribution of power between users, developers, administrators and owners of ICTs (Antoniadis, 2014). CWN and DIY networking can be a possibility to advance in all three aspects.

Community Wireless Networking technology evolved alongside wireless networks and it demonstrates a rich history of applications on various scales. Examples range from the Dead Drops by Aram Bartholl who simply plastered USB sticks into cracks in public spaces, creating very local networks;⁴ the Pirate Box, which allowed NYU students within the lecture hall to share files without breaching copyrights policies;⁵ to collectively owned and managed wireless infrastructures, such as, Freifunk in Berlin⁶ or the Metropolitan Wireless Network in Athens –

⁴ <https://arambartholl.com/dead-drops/>

⁵ <https://piratebox.cc/start>

⁶ <https://freifunk.net/en/>

one of the largest networks in Europe with 30.000 private antennas connected.⁷ It has become relatively easy to develop your own network, since the necessary hardware is affordable and the software has been made available through massive documentation of open source communities of practitioners. Still, there are many socio-economical and material barriers to those who are not technologically savvy, or don't have the time and resources that technological participation require (Haklay 2012; Rumbul 2015).

The MAZI (*together* in Greek) project, was looking to address this problem of alienation and participation.⁸ From a material technological perspective, the MAZI toolkit prototype was based on off-the-shelf components including Raspberry Pi⁹ and SD cards. The software was developed in part by the project partners while integrating existing Free/Libre/Open Software (FLOSS)¹⁰ to create a “plug and play” installation allowing for an easy-to-use local digital network with some pre-set applications. The technological prototype was accompanied by documentation and other physical materials such as posters, guidelines, and storytelling pamphlets, together making up the “MAZI Toolkit”. The project was led by various partners and took shape in Zurich, London, rural Greece, and Berlin, cross-seeding the techno-social development processes which were organized in parallel in the four local pilot projects. In each city a collaboration was established between a university and a community-based organization that led the local prototyping and implementation of the project.

The MAZI Berlin pilot was led by the Design Research Lab at the University of the Arts, Berlin (UDK), with the participation of various urban-activist initiatives which was led and facilitated by the non-profit organisation “Common Grounds” and its educational platform “Nachbarschaftsakademie” (The Neighbourhood Academy).¹¹ The pilot-team facilitated the collaborative prototyping processes in developing a DIY networking toolkit and implemented it in different contexts in the city of Berlin with the broader goal of advancing discourse and practice around the idea of digital sovereignty. Namely, it sought to address the individual and collective freedom and right to actively partake in the shaping of digital lifeworld; to interpret, define and take part in shaping discourse and imagination that is oriented toward community-driven digitally mediated futures. The Community Wireless Network toolkit was purposefully

7 <http://www.awmn.net/content.php?s=9fc8551534eefe7780d6e9f10b557103>

8 MAZI was a 3-year project, conducted between the years 2016-2018 and funded by the European Commission (H2020/CAPS).

9 Open source, modular, single board computer that was adopted widely for community use and education: <https://www.raspberrypi.org/>

10 <https://github.com/mazi-project/guides/wiki>

11 The Neighbourhood Academy, existing since 2015, is a self-organized open platform for urban and rural knowledge sharing, cultural practice and activism.

kept open for interpretation and engagement to allow for a meaningful long-term and open-ended participation and appropriation of tools and methods by the various actors who participated in the project.

The MAZI design prototype was treated as vehicles for iterative learning and keeping design decisions open, while conceptualizing participation through ongoing practices of design-in-use (Gregory, 2003; Suchman et al., 2002).¹² Espousing a critical political attitude, participatory approaches sought to embrace difference and conflict as resources for design, and incorporate discussions of political and ethical values as a goal in its own right (Gregory, 2003). Within processes of experimentation, the decision of whether the prototype should be high or low fidelity, paper sketch or material object, “messy” or “quick and dirty,” does not only relate to questions of flexibility, cost, and time, but also shapes a politics to the process. It determines who can participate in the process, what role one can play and how meaningful is one’s contribution.

Therefore, taking “messiness” seriously means openly engaging with issues of ownership, authorship, and control in the realms of technological development, and taking an active role in shaping its politics. Within such participatory processes, prototypes are conceptualized as “boundary objects” (Bogers and Horst, 2014; Powell, 2015; Star, 2010, Star & Griesemer 1989) that allow to rework the designer-user dichotomy and mediate between different social and epistemic positions. Relatedly, the idea of “design as infrastructuring” (Ehn 2002; Ehn 2008; Björgvinsson, Ehn & Hillgren 2010; Binder, De Michelis, Ehn, et al. 2011) allowed to withdraw from design as a nexus of problem-solving. Design processes understood and performed as “infrastructuring” are oriented towards long-term and complex processes of social transformation by creating environments and tools that allow affected communities to take an active part in addressing particular problems.

In the coming together of design and open-source culture, collaborative forms of prototyping turn both the prototype and the design process into a continuous state of “perpetual beta” (Unteidig, Calderón Lüning, & Dominguez-Cobrerros, 2017). This is where experimental or unstable versions of the design are released for use and at the same time continue to be in processes of development and documentation that are maintained by the community of users. This circular movement of open-source techno-social development has been analyzed by Christopher Kelty as the “unprecedented forms of publicity and political action” of free

¹² This shift in design practices that began in the later 1990’s was significantly informed by Scandinavian approaches to participatory and “cooperative design” (Bødker and Grønbaek, 1991; Gregory, 2003; (Hillgren, Seravalli, & Emilson, 2011); Kurvinen et al., 2008; Suchman et al., 2002).

software and other similar and related projects that emerge from it (2008, p. 4). Kelty brings forth the idea of Free Software as a “public” that is concerned with its legitimacy and independence from state-based forms of power and control, as much as corporate, commercial, and non-governmental power (Kelty, 2008, p. 9). Recursive publics, he explains, focus on the radical technological modifiability of their own terms of existence. Taking the case of the Berlin MAZI project, we follow the configuration of such “perpetual beta” and examine how the recursive dynamics of development and use open opportunities for producing political action and publicity that is resistant to tightening corporate sovereignty over digital realms.

MAZI Berlin constitutes one example of a range of projects that seek to advance democratic and bottom-up approaches to prototyping technology¹³. It was designed and implemented in three phases: first, community outreach and finding common ground for collaboration¹⁴; second, igniting the collaborative development of the CWN technology and adapting it to local context¹⁵; third, deploying the technology with partners in different settings¹⁶. The prototyping process evolved through these three phases and generated various boundary objects, while the main one was the MAZI hardware and software, there were more abstract ‘objects’ that brought people together such as Berlin itself and the community garden, “Prinzessinnengarten”.

The main element of the MAZI infrastructure, a self-built WIFI platform, acted as a boundary object for negotiating different expertise and enable cooperation between the different groups that took part in the Berlin project. However, it was the main locale chosen for MAZI Berlin, Prinzessinnengarten, that played a meaningful role in bringing together a diverse group of people. Prinzessinnengarten is an urban community garden in Kreuzberg that envisions and develops a collaborative and protected space for learning ecology, conviviality, and self-organization. It is also the space for the Neighbourhood Academy’s, a learning and knowledge exchange platform.¹⁷ The participants in the project included activists, artists, researchers, designers, engineers, social workers and local community members, all involved in one way or another with the Neighbourhood Academy,¹⁸ and were active around urban issues related to the

¹³ Subnodes by Sarah Grant (<http://subnodes.org/>); Open-source infrastructural project in Madrid (Jimenez, 2014); (Keysar, 2018); Decidim in Barcelon (Aragón et al., 2017), Public Lab: (Blair, Breen, Dosemagen, Lippincott, & Barry, 2013).

¹⁴ An exact division of phases in time periods is artificial since the phases partly overlap and are to certain extent on-going. Nevertheless, a rough division can be made. The first phase was mainly based in the first six months of 2016.

¹⁵ From July to August 2016 with continuous reiterations and improvements.

¹⁶ Throughout the project starting in January 2017.

¹⁷ <https://prinzessinnengarten.net/de/home/>

¹⁸ For a list of the initiatives that participated see footnote 21-23.

city of Berlin through the broad call for "the right to the city".¹⁹ The coming together of these elements mediated the participatory process, the development of technology, skills, and critical discourse on the possibilities of digital sovereignty.

The curated, but nonetheless experimental phases with the self-built toolkit, led participants to develop a sense of authorship and ownership in regard to network technology; it was also the ground for some of the conflicts and tensions we will analyze in the discussion section.

Phase 1 – Community outreach and creating common ground for collaborative technology development

The first phase of the MAZI Berlin pilot project aimed at situating and connecting the topic of Community Wireless Networking within the discursive realm of the participants. Both the shared interest in urban ecology advanced by the Neighbourhood Academy in the Prinzessinnengarten, and the broader urban issues that Berlin encompassed, enabled to create a forum of diverse actors and a basic level of trust that acted as a vehicle for collaborative work around CWN technology. Topics concerning land grabbing, privatization, financialization, centralization and new contested urban governance models for city planning echoed with critical technological issues that pose similar anti-democratic dynamics. Discussions revolved around the centralization of digital platforms and de-facto monopolies over digital services, and the financialization and commodification of daily digital interactions through datafication.

Two workshops were planned and held introducing the MAZI project and DIY networking technology. The first workshop sought to identify shared interests and discuss the relations between technological engagement and activism in the city. It concerned the development of mutual and productive relations between the different partners, growing trust, social ties and discussing different perspectives on what DIY networking is all about. The main part of the workshop was developed as a series of open discussions with all the participants introducing the idea of Collective Learning, a concept introduced by the Neighbourhood Academy to understand urban activism as a form of emancipatory learning. The second workshop shifted to discussions on the technological aspects of the project, by engaging in conversation about DIY-Networks and their potentials for digital self-determination.

¹⁹ The term "right-to-the-city" coined by the sociologist and urbanist Henri Lefebvre (1968) in the aftermath of the Parisian occupation, was argued as the "right-of-non-exclusion" from the qualities and services of the urbanized society and as a call to reclaim the city as a co-created space (Lefebvre, 1969; (Holm, 2011)).

Phase 2 – Collaborative development of technology

As part of the second workshop, initial technological ideas were formulated around the needs, wishes and desires related to matters of concern brought by participants. In these processes the idea of MAZI Zones was formulated, to allow for multiple deployments of the toolkit in Berlin by the various initiatives. With a focus on rapid prototypes, participants developed potential use cases for MAZI-Zones in different settings. The prototyping ideas from this workshop were further developed by the lead pilot-team (UDK researchers and the Neighbourhood Academy staff), through further co-design sessions. In these sessions, the Neighbourhood Academy at the Prinzessinnengarten was framed as the central interface and platform for collecting the learnings from the different MAZI experiences advanced by the various urban initiatives in the wider urban landscape of Berlin. The MAZI Archive software was developed by the Berlin lead pilot-team informed by the discussions, ideas and needs collaboratively formulated during the workshops. Its goal was to locally collect and disseminate user-generated content within the MAZI Zone, making it a local hub and an access point for visitors and users to get to know the project by connecting to CWN, learn about the technology, the people, and activities behind it and take part.²⁰

Phase 3 – Deploying MAZI-Toolkit in multiple local setting

The lead pilot-team engaged with a broad community, which included the urban initiatives that participated in the workshops as well as other groups and institutions that joined along the way. Aiming for openness and local-versioning of the toolkit to make it versatile for a growing community of users, MAZI Zones were put into use in different settings around Berlin. By the end of the project, the toolkit was deployed in thirteen different locales with the direct support of the lead pilot-team, and independently in other singular events or workshops that were also reported. It was used as research tools for seminars by academics in university settings universities;²¹ for communication and management in neighbourhood issues by a few communities in Berlin;²² for self-organising in protest related events;²³ as an interface between

²⁰ The software, “MAZI-Archive”, was hosted on a hardware setup consisting of a Raspberry Pi 3 (with a 16GB SD-Card), TP-Link TL-MR3020 Wi-Fi Router and an Anker Battery Pack. The router supplies an open Wi-Fi with the SSID “MAZI Archive”, which serves both for the data to be submitted by the recorder-application as well as an access point for users to interact with the content. After some testing in different settings, the MAZI-Archive application was integrated to the default version of the broader MAZI-platform.

²¹ Alice-Salomon-Hochschule and Chair for Urban Design Technical University Berlin and University of Arts in Braunschweig

²² The Neighbourhood Academy, ZK/U – Centre for Art and Urbanism, the Commons Evening School and the Neighbourhood Centre Kiezanker in Berlin-Kreuzberg.

²³ Bizim Kiez, Park Academy, Stadt von Unten, and the Anti-Google-Campus Initiative all active in the neighbourhood of Kreuzberg-Friedrichshain in Berlin.

researchers and visitors in the Berlin Natural History Museum; and for exploring the interdependence of digital tools and social innovation by the German Federal Ministry of Environmental Protection. The diverse setting in which MAZI-Zones were implemented required continuous development process for generating different kinds of documentations and tutorials that would fit various settings and goals. Most deployments started with a specific workshop format developed within the MAZI project called “unboxing”, where the toolkit was unpacked in order to let the participants get to know its components. Following was an introduction to the MAZI project, showing a pre-installed MAZI-Zone and subsequently letting each participant assembled their MAZI-Zone. On the one hand, this do-it-yourself format enabled a deeper understanding of the technology and approach of the project. On the other hand, It enabled to generate a space for hands-on engagement where participants were able to see and touch the different components of the DIY wireless network technology and build the toolkit themselves. This helped soften anxieties and reservations towards what seems to be “geeky” technology and allowed contributors to step into the “black box” of technology.

Fleshing out troubles and tensions on the way to digital sovereignty

The proliferation of digital and data-driven mediations of social and political urban life was the motivational nucleus on which mutual interest and understanding was developed in MAZI Berlin. While the “right-to-the-city” discourse raises demands for democratic participation in the production of urban space, the topics under discussion in MAZI evolved around similar logic. It fleshed out needs and demands for democratic participation in the production of digital infrastructures and futures, challenging the normativity of corporate, proprietary technological development that shapes countless aspects of our lives (Unteidig et al., 2016).

With these joint ideological and activist trajectories in mind, the experimental aspects of prototyping the CWN technology enabled to engage participants in developing tools and practices that would extend their urban activism within the realms of technology. Developing and using the MAZI toolkit facilitated a collaboration in which the emphasis was on the productive and processual aspects of experimentation (Jiménez, 2014). As Jiménez remarks, prototyping incorporates failure as a legitimate result in the realization of the process and stands for reconfiguring, at once, material objects and social relations. It is a “surrogate,” he argues, for new experiences and processes of democratization (Jiménez, 2014).

While we share these orientations, our case study analysis is set to flesh out the dilemmas and problems that might emerge within such urban experiments. What might be the

inadvertent consequences of challenging the rigid boundaries of expertise through open-source tools? What happens when experimental, techno-social visions are met with “old” politics, and entrenched social, political, economic perceptions, divides and inequalities? As Corsín Jiménez remarks, prototyping is a process of trial and error, and embracing failure can allow for the emergence of inventive practices and social relations. However, who is accountable for the upshots of failure beyond the experimental and visionary realms of prototyping; how is failure mitigated within the realities of social context and locally situated interventions?

With these questions in mind, we now focus on three such perspectives on tensions and troubles that came up in the MAZI Berlin and unpack some current challenges that may stand in the way of advancing digital self-determination and autonomy through collective control.

Reworking structural power relations in academy-community partnership

Comparing the dynamics between struggles for urban infrastructure and technological infrastructure in the city, helped to bring people together around the MAZI, but it was only a first step. Academy-community partnership brings with it some tensions; there are potential contradictions between the realms of the research project and the expectations, responses and concrete needs brought by participants. During the MAZI Berlin project there were demands placed on the various urban initiatives that participated, investing their time, skills, and knowledges in the project. This required to establish clarity in regard to the concrete benefits participants would gain from taking part in the project. A level of reservation toward the collaboration was evident as participants addressed the phenomenon of "academic harvesting", i.e., the one-sided withdrawal of knowledge by researchers, which was clearly articulated through discussions during the workshops. As one member of the Neighbourhood Academy reported, over the years there has been a considerable burden on the workload due to the fact that the community garden has become the subject of countless Bachelor's, Master's and Doctoral theses. While the activists welcomed such collaborations, there was usually no concrete and immediate exchange value and, in many cases, research findings and outcomes were not shared with the participants.

Through a long-standing engagement with the urban initiatives, the Neighbourhood Academy played the role of a gatekeeper and facilitator for building productive collaborations and relationships with various settings. In participatory research the community gatekeeper acquires an important role, as they hold the power to allow or deny access to particular communities or institutions (Lenette et al., 2019). In the MAZI project, these roles were part of the negotiation between the UDK and the Neighbourhood Academy from the very early stages.

Hence, trust, was something that needed to be established first within the pilot lead-team before it could advance with the participating urban initiatives. This also needed a surfacing of undervalued and ‘invisible’ forms of labour (D’Ignazio & Klein, 2016) that go into creating lasting relationships and trust throughout the communities. This initial robustness in reflecting roles and expectations, helped set a standard of reciprocity for the rest of the project. It enabled to critically rework power relations and specifically address the need for a two-way relationship to make sure that the outcomes of joint efforts are also equally distributed (ibid).

Evolving from the initial discussions within the lead pilot-team, the strategy was to financially compensate the initiatives participating in MAZI Berlin for sharing their expertise and insights in workshops and other events. This was accompanied with a transparent discussion on the financial structure and available funds in the framework of the project. Furthermore, the reciprocal sharing of skills and knowledges during workshops related to CWN technology, constituted another aspect for establishing a more equal exchange. The workshops provided the base for collectively prototyping the MAZI toolkit, but moreover, they created a shared space for different initiatives to exchange resources, challenges and needs. Finally, the actual deployments of MAZI Zones (project’s third phase) allowed to establish shared ownership and use of hardware and software, serving the initiatives in their independent projects.

Between experimental realms and epistemic norms

While all these arrangements and agreements sound like solutions, tensions that stood in the way were entangled in more complex set of epistemic norms and expectations that many times pose significant challenges in collaborative, civic and open source projects (Rey-Mazón, Keysar, Dosemagen, D’Ignazio, & Blair, 2018). Community wireless networking through DIY technology is a relatively new idea for introducing the political potentials of decentralized/local ownership and management of technology and data (Antoniadis 2016). For CWN to become a tool for community-driven digital sovereignty, a prerequisite is a community-based awareness and capacity to exercise control over the development and implementation of digital technologies. While critical awareness to the patterns of corporate sovereignty over technologies and data was shared among participants, the success of the project was dependent on overcoming the basic alienation most people feel toward experimental, “half baked” technology, which requires significant investment before it fully performs its tasks; and furthermore, challenging the perceived role of experts as service providers who deliver solutions and reliable technological outcomes.

Asymmetries in technical expertise, contextual and local knowledge, institutional contexts, or privilege can easily stand in the way of such efforts. The disciplinary and epistemological backgrounds brought by the heterogenous actors – activists, designers, researchers, neighbours - diverged widely and required mediation. In that regard, the design researchers had a strong interest in experimental work that tests different prototypes and cultivates openness in regard to techniques, interfaces and use-cases as part of the collaborative process of development. In contrast, activists expected for a certain level of performance by the experts/designers amplified by particular sets of needs shared by many protagonists of the urban initiatives. Usually working under comparatively precarious conditions toward goals that are difficult to achieve, urban political initiatives have little time to “stray” or “tinker” around for the purpose of mere exploration. An exploratory, open design process with detours and a high degree of ambiguity may very well result in counter-productive results.

Infrastructuring against the troubles of project logics

Another inherent tension in academy-community partnerships emerges between the realms of continuous and often strenuous processes of community activism and the structures and logics of project-based interventions. Project logic often relate to the rigid structure that determines how work is organised and managed in research and development projects, within the hierarchies of academic institutions and funding organizations (Torka, 2009). Academia and funding bodies demand the process to be structured by clear beginning and end dates, as well as agreed-upon deliverables and, usually, a certain degree of positivistic pressure (as in the need to deliver a solution to a previously described problem). Relatedly, these pressures had to be negotiated with the continuous nature of community concerns and activities.

More importantly, the project partners had to identify and negotiate ways to deliver an outcome that would adhere to institutional requirements, and at the same time ensure that the MAZI Berlin will have a lasting and meaningful effect. To follow the aspirations of open-source culture, MAZI had to grow a community that would continue to use and maintain tools and techniques for CWN technology and activity, even after the official end of the funded project. The problem of maintenance and sustainability of the MAZI Berlin was addressed halfway through the project by the lead pilot-team by shifting from a focus on project ‘outcomes’ to thinking and developing infrastructures for “everyday design activities in actual use” (Björgvinsson, 2012, p43). Correlating with the idea of the recursive public in open-source culture (Kelty 2008), such an approach is oriented toward designing infrastructure that would

provide support for a self-organised community around CWN technology and, more importantly, provoke its creation.

Infrastructuring in that regard included design choices on hardware and software level that were oriented toward adaptability and ease of use; as well, documentation and knowledge repositories extended well beyond technical issues to include storytelling of exemplary use cases of MAZI Zones and lessons learned. Furthermore, a strong emphasis was given on technical training and the careful establishment of a “community-of-practice” (Wenger, 1998) that would make it possible and probable that future projects will continue growing from the infrastructures established by MAZI Berlin.

Nonetheless, on a more technical but fundamental level, long-lasting usability and necessary maintenance of DIY technologies remains a problem within the context of academic research projects. While the MAZI Berlin lead pilot-team focused on certain aspects of the design and its long-lasting effect, the project’s structure and logic could not possibly provide for upward compatibility, meaning, a continuous updating of the toolkit to adapt with external hardware upgrades. As a result, the software providing the base for the MAZI toolkit is not supported by current versions of the Raspberry Pi, and it is becoming increasingly difficult to acquire older versions of the microcontroller in order to use the toolkit. With no remaining funding, and the academic and technical leaders of the project having moved on to other endeavours, sustainability and maintenance proves very difficult – and would merely be a temporary step towards the same problem repeating itself with the next major version update of the technology in use.

In retrospect, some of these efforts indeed proved fruitful – a few of the workshop participants²⁴ found their own ways of acquiring funding and continuing the use and development of MAZI, and new projects in entirely different contexts have been initiated building on the toolkit and its accompanying repositories.²⁵ However, complexities remain and are inherent to the overarching project of community-driven digital sovereignty and the broader idea of prototyping technologies in academia-community partnerships.

24 The neighbourhood centre “Kiez Anker 36” has thus far had three follow up projects: StadtTeilen (<https://stadtteilen.org/forschung/>) funded by the Robert Bosch Foundation, PRoSHARE (<https://jpi-urbaneurope.eu/project/proshare/>) under the European funding program Urban Migration, and Kiezesgeschichten (<https://stadtprojekte.org/2020/12/kreuzberger-kiezesgeschichten/>) financed by the German Federal Ministry of Education and research

²⁵ For example: Miadé (<https://www.dfki.de/en/web/news/detail/News/lokale-community-netzwerke-fr-togo0/>) - Local Community Networks for Togo by the German Research Center for Artificial Intelligence

Conclusion

The MAZI project aimed at building alternative technologies specifically developed in local contexts and experimenting with new and alternative models of ownership, governance, and administration. Beyond the technical aspect, the project continuously intertwined operative (technical) activities with the building of critical discourse and counter-narratives on urban technological futures. Furthermore, a leading objective of the MAZI project has been the exploration of ways in which technology can be conceptualized and developed through collaborative prototyping in hyper local contexts with non-technological communities.

MAZI is one of many efforts that seek to advance democratic and bottom-up approaches to prototyping technology. The case study analysis sought to critically reflect on dilemmas and shortcomings that emerged during the project and can provide valuable insights for future endeavors. Roles, mandates, and power structures have to be made explicit in order to be addressed and collectively approached as contingent objects that can be navigated, altered and adapted (Freeman, 1970). This is crucial in order to avoid reproducing forms of domination and to establish more horizontal systems of knowledge co-production. To counteract these tendencies the MAZI case study shifted its focus toward creating and developing design infrastructures that could provide support for self-organized communities beyond the scope of the funded timeframe. The approach of creating infrastructures through the various processes of participatory design correlated well with the needs of academia/community collaborations, but nonetheless it had its own limitations. If not carefully negotiated, such differences in expectations, agendas and epistemic frameworks might not only hamper project activities themselves but may well prove counterproductive and harmful.

The need to prototype tools for a technological and civic infrastructure correlates with current concerns in regard to the creation and management of “critical infrastructures” in the city, which are mostly expressed in relations to the risks of climate change (Klinenberg, 2016). As Klinenberg and others suggest, critical infrastructures for safeguarding cities are not only about mitigating disaster damage but also about growing awareness to collective vulnerability and addressing dominant political and social institutions (Howe and Boyer, 2016; Klinenberg, 2016). By bringing together the discourses and practices that revolve around urban and technological rights-to-the-city the MAZI Berlin case study enables us to draw invisible lines between different articulations of critical infrastructures, whether in urban, environmental, technological, or epistemological realms. These transfigurations of urban infrastructures raise questions in regard to the possible emergence of a political discourse that brings together ideas and techniques that are usually thought of and practiced in isolation.

While MAZI Berlin successfully brought together discourses and practices that revolved around the articulation of urban and technological rights to the city, it nonetheless risked reproducing the very forms of domination that it was set to work against. Embracing openness as a consciously political alternative, means inextricably intertwining it with accountability to the realities of social context and the potential consequences of locally situated interventions. Experimental processes might be indispensable for prototyping civically and community-oriented technologies but at the same time may actually stand in the way of advancing digital participation, self-determination and autonomy.

Bibliography

- Anderson, F. (2018). Soberanía Alimentaria Ya! Una Guía por la Soberanía Alimentaria. In E. C. V. Campesina (Ed.). Brussels, Belgium.
- Antoniadis, P. A., Ileana (2014). The Right(s) to the Hybrid City and the Role of DIY Networking *The Journal of Community Informatics, Special Issue: Community Informatics and Urban Planning*, 10(3). doi:<https://doi.org/10.15353/joci.v10i3.3450>
- Antoniadis, P. (2016). DIY networking: The path to a more democratic internet. *The Conversation Global*, 8.
- Aragón, P., Kaltenbrunner, A., Calleja-López, A., Pereira, A., Monterde, A., Barandiaran, X. E., & Gómez, V. (2017). *Deliberative Platform Design: The Case Study of the Online Discussions in Decidim Barcelona*, Cham.
- Benkler, Y. (2006). *The Wealth of Networks: How Social Production Transforms Markets and Freedom*. New Haven: Yale University Press.
- Björgvinsson, E., Ehn, P., & Hillgren, P.-A. (2010). Participatory design and democratizing innovation. Paper presented at the 11th Biennial Participatory Design Conference, New York.
- Blair, D., Breen, J., Dosemagen, S., Lippincott, M., & Barry, L. (2013). Civic, citizen, and grassroots science: Towards a transformative scientific research model. *Accountability technologies: Tools for asking hard questions*, 23-31.
- Bogers, M. and Horst, W. (2012). An Exploration of Collaborative Prototyping. In: DRUID Summer Conference. [online] Copenhagen: DRUID Society, pp. 1-47. [Accessed 24 Oct. 2016].
- Bødker, S., and Grønbaek, K. (1991). Cooperative Prototyping: Users and Designers in Mutual Activity. In: S. Greenberg, ed., *Computer-supported Cooperative Work and Groupware*, 1st ed. London: Academic Press, pp. 331-358.
- Boyd, D., & Crawford, K. (2012). Critical questions for big data: Provocations for a cultural, technological, and scholarly phenomenon. *Information, Communication & Society*, 15(5), 662-679.
- Couture, S. a. S. T. (2019). What does the notion of “sovereignty” mean when referring to the digital? *new media & society*, 1 –18.

- D'Ignazio, C., & Klein, L. F. (2016). Feminist Data Visualization. Paper presented at the IEEE.
- Floridi, L. (2020). The Fight for Digital Sovereignty: What It Is, and Why It Matters, Especially for the EU. *Philosophy & Technology*, 33, 369–378. doi:<https://doi.org/10.1007/s13347-020-00423-6>
- Gregory, J. (2003). Scandinavian Approaches to Participatory Design. *International Journal of Engineering Education*, 19 (1), pp. 62–74.
- Guggenheim, M. (2014). From Prototyping to Allotyping. *Journal of Cultural Economy*, 7 (4), pp. 411–433.
- Haché, A. (2014). La souveraineté technologique. [Technological Sovereignty]. *Mouvements*, 79(3), 38-48. doi:10.3917/mouv.079.0038
- Hackney, A. and Manar E. (2015). Prototype. In: *UXL Encyclopedia of Science*, 3rd ed. Farmington Hills: UXL.
- Haklay, M. (2012). Citizen Science and Volunteered Geographic Information: Overview and Typology of Participation. In: Elwood S., Goodchild M. and Sui D. eds., *Crowdsourcing Geographic Knowledge*, 1st ed. New York: Springer, pp. 105– 122.
- Hillgren, P.-A., Seravalli, A., & Emilson, A. (2011). Prototyping and infrastructuring in design for social innovation. *CoDesign*, 7, 169-183. doi:10.1080/15710882.2011.630474
- Holm, A. (2011). Das Recht auf die Stadt. *Blätter für deutsche und internationale Politik*, 8, 89-97.
- Howe, C. and Boyer, D.(2016). Aeolian Extractivism and Community Wind in Southern Mexico. *Public Culture*, 28 (2), pp. 215–235.
- Jiménez, A.C. (2014). Introduction: The Prototype: More than Many and Less than One. *Journal of Cultural Economy*, 7 (4),
- Jimenez, A. C. (2014). The Right to Infrastructure: A Prototype for Open Source Urbanism. *Environment and Planning D: Society and Space*, 32(2), 342–362.
- Kelty, C.M. (2008). *Two Bits: The cultural Significance of Free Software*. Durham: Duke University Press Books.
- Kelty, C.M. (2010). Prototyping Prototyping: A Preface. *Limn*, [online] 1. Available at: <http://escholarship.org/uc/item/5z46j29f> [Accessed 24 Oct. 2016].
- Keysar, H. (2016). Prototyping the Civic View from Above: Do-It-Yourself Aerial Photography in Israel-Palestine. *Politics and Government*. Beer Sheva, Ben-Gurion University. Doctor of Philosophy.
- Keysar, H. (2018). A spatial testimony: The politics of do-it-yourself aerial photography in East Jerusalem. *Environment and Planning D: Society and Space*, 37(3), 523-541.
- Klinenberg, E. (2016). Climate Change: Adaptation, Mitigation, and Critical Infrastructures. *Public Culture*, 28 (2), pp. 187–192.
- Kurvinen, E., Koskinen, I. and Battarbee, K. (2008). Prototyping Social Interaction. *Design Issues*, 24 (3), pp. 46-57.

- Lefebvre, Henri (1996), "The right to the city", in Kofman, Eleonore; Lebas, Elizabeth (eds.), *Writings on cities*, Cambridge, Massachusetts.
- Lenette, C., Stavropoulou, N., Nunn, C., Kong, S. T., Cook, T., Coddington, K., & Banks, S. (2019). Brushed under the carpet: Examining the complexities of participatory research. *Research for All*, 3(2), 161-179. doi:DOI <https://doi.org/10.18546/RFA.03.2.04>
- Lezaun, J. and Calvillo, N. (2014). In the Political Laboratory: Kurt Lewin's Atmospheres. *Journal of Cultural Economy*, 7 (4), pp. 434–457.
- Marcus, G. (2014). Prototyping and Contemporary Anthropological Experiments With Ethnographic Method. *Journal of Cultural Economy*, 7 (4), pp.399–410.
- Mayer-Schönberger, V., & Cukier, K. (2013). *Big data: A revolution that will transform how we live, work, and think*: Houghton Mifflin Harcourt.
- Powell, A. B. (2012). Democratizing Production through Open Source Knowledge: From Open Software to Open Hardware. *Media, Culture and Society*, 34 (6), pp. 691– 708.
- Pohle, J. (2020). Digitale Souveränität. In T. Klenk, F. Nullmeier, & G. Wewer (Eds.), *Handbuch Digitalisierung in Staat und Verwaltung*. Wiesbaden: Springer VS, Wiesbaden.
- Pohle, J., & Thiel, T. (2021). Digital Sovereignty. In B. Herlo, D. Irrgang, G. Joost, & A. Unteidig (Eds.), *Practicing Sovereignty. Means of Digital Involvement*. Bielefeld: Transcript. (Forthcoming)Rey-Mazón et al. 2018
- Rey-Mazón, P., Keysar, H., Dosemagen, S., D'Ignazio, C., & Blair, D. (2018). Public lab: Community-based approaches to urban and environmental health and justice. *Science and Engineering Ethics*, 24(3), 971-997.
- Ritzi, C. a. Z., Alexandra. (2019). Souveränität unter den Bedingungen der Digitalisierung. In I. S. Borucki, Wolf Jürgen (Ed.), *Internet und Staat. Perspektiven auf eine komplizierte Beziehung: Nomos*.
- Rumbul, (2015). Who Benefits from Civic Technology? My Society, [online] [Accessed 24 Oct. 2016].
- Star, S.L. (2010). This is Not a Boundary Object: Reflections on the Origin of a Concept. *Science, Technology and Human Values*, 35 (5), pp. 601–617.
- Suchman, L. (2000). Embodied Practices of Engineering Work. *Mind, Culture and Activity*, 7 (1-2), pp. 4–18.
- Suchman, L., Trigg, R. and Blomberg, J. (2002). Working Artefacts: Ethnomethods of the Prototype. *The British Journal of Sociology*, 53 (2), pp. 163–179.
- Thiel, T. (2019). Souveränität: Dynamisierung und Kontestation in der digitalen Konstellation. *EconStor Open Access Articles, ZBW - Leibniz Information Centre for Economics*, 47-60.
- Torka, M. (2009). *Die Projektförmigkeit der Forschung*. Baden-Baden: Nomos Verlag.
- Unteidig, A., Domínguez Cobreros, B., Calderón Lüning, E., Heilgmeir, A., Clausen, M., & Davies, G. (2016). *Desing, progress and evaluation of the Prinzessinnengarten pilot (version 1)*.

Unteidig, A., Calderón Lüning, E., & Dominguez-Cobrerros, B. (2017). Design, progress, and evaluation of the Prinzessinnengarten pilot (version 2).

Unteidig, A., et al. (2017). "Digital commons, urban struggles and the role of Design." *The Design Journal* 20: 3106-3120.